

The Environmental Corner

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Fate Of Spilled Perc In The Subsurface

Understanding the Basics When it Gets in the Ground

Releases of perchloroethylene (perc) to the subsurface from dry-cleaning operations and related perc handling are not rare. The result of environmental investigation in response to a confirmed spill is not only to determine the concentration of materials in the ground, but to develop a conceptual site model as to where the contaminant is going. Once a model of what's there, where it's going and how it's getting there has been constructed, a remedy can be selected and implemented.

The releases at the surface consist of primarily two types. Free phase perc in dense non-aqueous phase liquid (DNAPL) pure form and dissolved phase perc in water. Current accidental releases are often spills resulting from the drycleaning process. Historically, chemical handling practices were not as refined as they are today and there may have been releases related to cleaning of filters; distiller boil-overs; storage equip-

ment failures, or disposal of hazardous process waste as well as spills from older drycleaning machines and operations. The perc may be introduced to the subsurface on dirt or gravel, which allows an easy pathway to the soil, or will travel directly, through untreated concrete (and can even dissolve asphalt).

The perc in pure or dissolved phase will adsorb to soil particles as it migrates downward (gravity flow).

These adsorbed molecules of perc are then quantified later by selecting soil samples during soil coring activities. In some cases, the geology at a site will be such that the released materials will have a preferential pathway along a seam of sand or even a utility corridor. The spilled perc will then appear to have spread out.

As frequently observed, the perc will migrate deep enough to where groundwater is encountered and a groundwater contamination plume is initiated. Should geological conditions allow, a migrating DNAPL plume will continue to "dive" into the saturated subsurface to a point where it will pool on an impermeable or less permeable geologic unit

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Cleaner & Launderer

July 2011

and continue to dissolve into the groundwater.

A basic investigation into groundwater flow determines two important characteristics: direction and velocity. A dissolved phase perc plume will travel in the direction of groundwater flow. Groundwater, more than any other mechanism, is the likely culprit for perc leaving a drycleaner spill site and onto a neighboring property. Through aquifer investigation, flow characteristics can be determined and the flow of a contaminant plume can be better understood and perhaps predicted.

The fate and transport of the dissolved phase perc plume in groundwater is also affected by other non-destructive and destructive processes. Some of these non-destructive processes include absorption onto organic matter; dilution of perc concentration by recharge of cleaner groundwater from upgradient and surface percolation of rainwater; and volatilization of the perc from the groundwater plume. One of the most important destructive processes working on perc plumes is called reductive dechlorination which includes naturally occurring subsurface microbes available in saturated units, a process occurs to DNAPL, adsorbed phase, and dissolved phase perc. The dechlorination or degradation process produces daughter products as it works toward non-regulated non-toxic compounds. The primary daughter products

include trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-DCE), trans-1,2-dichloroethylene (trans-DCE), and vinyl chloride (VC). The daughter products can be as dangerous to human health and the environment as perc (in some cases, more dangerous). During the investigation, these daughter products are commonly detected in the groundwater samples and provide information on the naturally occurring chemistry at a site.

Perc and its daughter products are volatile in nature and will volatilize into vapor phase impacts. The vapor phase impact will be present in the soil and can enter basements, crawl spaces, and the breathing space in surface structures. Contaminants may also follow preferential pathways such as underground utility corridors speeding up the migration of the contaminants where present. Vapor intrusion investigations have become increasingly more prevalent in recent years and are needed to prevent risk of solvent exposure to inhabitants in adjacent buildings and residences.

The multi-phase transport nature of perc and daughter products in the subsurface creates a significant challenge to characterize. It is important to keep up with the most recent advances in investigation technology and interpretation techniques so that a successful and cost effective remediation methodology can be employed on a site specific basis.

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